PROBLEM SOLVING SET IN DIFFERENT AGE GROUPS

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CHAPTER I

DEVELOPMENT OF THE PROBLEM

Purpose. This investigation is concerned with the relationship between increasing chronological age and certain aspects of experimentally induced problem solving set. The three main variables to be studied for different age groups are: (1) susceptibility to set, (2) ability to overcome set, and (3) the relative effectiveness of attempts to train subjects to avoid set.

Definition of terms. For this study, problem solving set is defined as the tendency to continue the use of a given method, because it has previously proven effective, in the solution of later problems in a series.

Susceptibility to set is operationally defined in terms of the number of problems in a series, having alternative solutions, on which an individual continues to employ the previously effective method.

Ability to surmount set is operationally defined in terms of an individual's solution, within a specified time, of a problem not soluble by the set approach, when it is placed after a series of problems on which the set approach is effective.

Trainability in avoiding set is defined in terms of the relative susceptibility to set and ability to surmount set of subjects in a

problem solving situation before and after training. Training, in this study, consists of exposure to the effects of problem solving set on one of two tests and an explanation of these effects in terms of the subject's performance.

Theoretical and practical implications. There are reasons for expecting age differences in the variables described above. Ruch (21), Strong (24), and Hinshaw (9), from studies of interests, attitudes, and opinions, indicate that older people are more conservative and show a resistance to change. This resistance might also enter into problem solving behavior. Overcoming the influence of problem solving set involves an ability to change one's approach or point of view.

Thorndike's demonstration of a drop in learning ability with advancing age may also be cited. Whereas Thorndike (25) attributes this change primarily to lack of practice, and decreased interest, motivation, or opportunity for learning, Wechsler (28) ascribes the drop to progressive organic deterioration. If the present study finds evidence that set effects decrease with training, an explanation in terms of organic deterioration would be less plausible.

Age variations in set effects are practical considerations for those interested in adult education. If older people show greater

set effects, perhaps different teaching and training methods should be employed with them to allow for this fact. For example, drill could be given less emphasis with them, and the possible advantages of a readiness to consider alternative solutions could be pointed out. Another application is in the employment and placement of workers from different age groups. On some jobs, a strong tendency to fall into set patterns may be advantageous. On others it may be undesirable. Workers in personnel and vocational guidance may use information about age differences in set effects to help them in choosing the best men for a job or the best job for a given individual.

Einstellung Tests. Luchins' Water Jar is perhaps the most commonly used measure of problem solving set and has served as a prototype for many variations. This test consists of a series of problems in which, given three water jars, each holding a different amount, the subject is required to get a prescribed amount of water. A model of the test design is presented below:

Capacity in Quarts of Containers Given			To Get	Description
a	b	c		
29	3	-	20	Explained example.
21	127	3	100	Set inducing problems
:	:	:	:	calling for b-a-2c solution.
23	49	3	20	Criticals, permitting either
:	:	:	:	b-a-2c or a-c solutions.
28	76	3	25	Extinction problems, not soluble by b-a-2c.

The first problems are soluble by a common method and the subject usually comes to adopt this as the effective approach. If the three jars were labeled a, b, and c, an expression of the "formula" would be b-a-2c. Eventually, problems are introduced in which either this formula or a simpler one, a-c, will work. Next, an "extinction" item is introduced which cannot be solved by the long method. This may be followed by other ambiguous or "critical" items which can be solved either way.

In a monograph (12), Luchins reports giving the test to over nine thousand subjects, mainly grade school students. He was particularly impressed with performances under different conditions. He allowed different times and used different instructions, emphasizing speed, and the "test atmosphere" or de-emphasizing them. Additional variations and the effects under different conditions are reported in studies published since this monograph by Luchins (13, 14, 15, 16, 17) and others (1, 2, 7, 11, 19).

Tresselt and Leeds (26, 27) found a straight line relationship between set induced and the number of set inducing items up to six. They also verified Luchins' findings that set solutions occur about equally under concrete and abstract conditions--using real water jars or simple written problems. Kendler, Greenberg and Richman (10) demonstrated that massed practice conditions develop a stronger Einstellung effect than distributed practice.

A number of studies have been conducted attempting to relate Einstellung performance to ethnocentrism and to anxiety, with generally conflicting results. None of these offered any evidence on age differences, nor did any of the investigations reported here except Luchins' monograph.

Two studies are particularly important as logical foundations of the present investigation. Guetzgow (8) offered evidence that ability to surmount set, shown by the Einstellung extinction problem, and susceptibility to set, shown by set solution of the critical problems, are separate phenomena representing different abilities. The second study is by Schroder and Rotter (23). They demonstrated the effect of reinforcing the use of new alternatives on problem solving set. Their subjects with more diverse training were better able to adjust to a simpler solution procedure in a series of problems when it became possible to do so.

Luchins did not seem primarily interested in age differences and offered little information on this variable. He does record one observation on the subject:

> Large Einstellung effects were obtained in all experimental groups, whether they were composed of elementary school children, college students, graduate-students, adults with no formal education, or college professors. Although the groups did not differ greatly in Einstellung effect, they did differ strikingly in the amount of recovery from it. The various methods introduced to produce recovery were usually not effective in the elementary school groups but were effective in the other groups. (14, p. 90).

In a personal letter to the author, Luchins said that the data from his monograph (12) had been re-worked statistically. He also referred to a doctoral dissertation by V. M. Ross (20) using adults of various ages. Evaluating these, Luchins says, "Our work points to the increase of rigidity with age although the difference is not very great."

Cowen, Wiener, and Hess (6) have offered data indicating that an alphabet mazes test, which they developed, is significantly correlated with a version of the Water Jar Test. These mazes tend to build up a habit in which the subject takes a characteristic, indirect path from start to finish. Then a shorter path becomes available also. On the extinction problem, a new path must be used.

An example of the type of problem they used follows:

					*
A	X	G	R	V	H
L	O	K	Q	I	V
B	V	Z	S	J	K
G	Q	B	X	W	N
P	E	Z	M	A	O
D	N	O	B	R	I
*					

The subject is instructed to find a continuous path of words from the upper right hand corner to the lower left hand corner. He is allowed to go one letter at a time in any direction. The problem shown is one of the critical type. Note that two solutions are possible. The direct path spells out "His bed." The Einstellung path spells "His war

bond." On the extinction item, neither of these paths led to a solution. The subject had to find a new path similar to that used in one of the practice items.

This test provides a type of alternate measure for use in assessing training effects on set behavior. By giving the two tests in counterbalanced order and interposing an explanation after the first test given, it should be possible to assess age differences before and after a standard amount of training.

Specific hypotheses to be tested. This study seeks to determine whether there is any relationship between increasing chronological age and various aspects of problem solving set. The specific hypotheses to be tested may be expressed as follows: (1) There are no age differences in susceptibility to problem solving set. (2) The ability to overcome or surmount an experimentally induced set is unrelated to age. (3) The effect of training in avoiding problem solving set is unrelated to age.

CHAPTER II

SUBJECTS, TESTS, AND PROCEDURE

Subjects. Each of the three age groups was composed of 50 male and 50 female subjects. All were living in Florida at the time they were tested. Table 1 shows the age distribution within each sub-group. The older group, composed mainly of retired people, ranged from age 50 to 85, with a median age of 66.02. The middle age group ranged from age 20 to 49. Their median age is approximately half that of the older group, 31.75. The younger group ranged from age 14 to 19. Their median age of 16.05 is about half that of the middle group.

Distribution of the groups according to occupational level is presented in Table 2. The categories are those used by the United States Bureau of the Census. This table gives some idea of the comparability of the sub-samples and of their representativeness. That is, each sample can be compared with the other samples as well as with the population it is supposed to represent. Except for a very small number who were employed themselves, members of the younger group were placed according to their parent's occupation. The working parent was generally the father, of course. Older people were most often placed according to what their main occupation was before they retired.

Table 3 shows the distribution of the sub-groups according to education. Since there are 100 in each age group, the frequencies may also be read as per cents. The last column indicates the percentage grouping of the entire sample of 300.

Table 1

AGE DISTRIBUTIONS IN SAMPLES OBTAINED

Younger (14-19)			Middle (20-49)			Older (50-85)		
Age	M	F	Age	M	F	Age	M	F
14	6	6	20-24	10	13	50-54	4	4
15	13	14	25-29	9	9	55-59	2	9
16	11	9	30-34	8	12	60-64	16	8
17	12	9	35-39	9	6	65-69	7	16
18	4	10	40-44	5	5	70-74	8	8
19	4	2	45-49	9	5	75-over	13	5
	50	50		50	50		50	50
Mdn.	16.05	16.06		33.25	30.75		66.64	65.75
	16.05			31.75			66.02	

TABLE 2

OCCUPATION DISTRIBUTIONS IN SAMPLES OBTAINED
(USUALLY PREVIOUS OCCUPATION FOR OLDER AND PARENT'S OCCUPATION FOR YOUNGER GROUPS)

Major Occupational Group	Younger		Middle		Older	
	M	F	M	F	M	F
A. Not in Labor Force	1	1	6	20		34
B. In Labor Force						
1. Profess. & Tech.	8	7	12	4	12	5
2. Farmers & Farm Mgrs.	2	1	2		6	
3. Mgrs., Offs., & Props.	5	10	5		9	
4. Clerical & Sales	9	9	8	24	8	7
5. Craftsmen, Frmn., & Ops.	16	12	14	1	11	
6. Hshld. & Service Wkers.	2	5	2	1	4	4
7. Laborers	3	3	1			
C. Military	4	2				
	50	50	50	50	50	50

TABLE 3

EDUCATION DISTRIBUTIONS IN SAMPLES OBTAINED

Highest Grade Completed	Age			
	14-19	20-49	50-85	14 and over
Less than 8	2	2	4	2.67
8 through 11	88	12	52	50.67
12 through 15	10	70	28	36.00
16 or more		16	16	10.67
N and %	100	100	100	100.01

The actual census data for the United States in 1950 are given in Tables 4 and 5 for occupation and education. Comparison of these figures with the sample distributions in Tables 2 and 3 shows that all of the samples are above the national average in education and are generally from the "higher" occupational categories. Any generalizations made of the results obtained from these samples must, of course, take these biases into consideration. The groups are more representative of a "middle class" population than of the population as a whole.

Subjects in the older group were generally tested individually or in pairs in their own homes or apartments. Those in the middle age sample were most often tested individually at their working place, during or after working hours. Younger subjects were mostly volunteers from high school study-halls and classes. Nearly all of these were tested in groups of two or three.

The tests. Cowen, Wiener and Hess (6) had demonstrated the comparability of two structurally similar Einstellung tests. However, both of these proved to be too difficult for subjects in the present sample. Accordingly, a simpler form of the water jar test was adapted from Cowen and Thompson (5), and the alphabet mazes test was modified and made simpler. Both tests were put into the form of small booklets with each problem on a separate page. This allowed subjects to work at their own pace and enhanced the "massed practice" effect, found more set-inducing by Kendler, Greenberg, and Richman (10).

TABLE 4

OCCUPATION DISTRIBUTION OF UNITED STATES CIVILIAN LABOR FORCE, 1950

(From 1950 U.S. Census of Population, Special Report P E No. 1C
Bureau of Census Preprint of Volume IV, Part 1, Chapter C.)

Major Occupational Group	Percent Distribution	
	Males	Females
Professional and Technical	7.3	12.3
Farmers and Farm Managers	10.3	0.7
Managers, Offs. and Proprietors	10.7	4.3
Clerical and Sales	12.8	35.8
Craftsmen, Foremen, and Operatives	38.7	20.7
Household and Service Workers	6.1	20.7
Laborers	12.9	3.7
Occupation not Reported	1.1	1.8
	100%	100%

TABLE 5

EDUCATION DISTRIBUTION OF UNITED STATES POPULATION, 1950
(From 1950 U.S. Census of Population, Special Report P E No. 5B
Bureau of Census Preprint of Volume IV, Part 5, Chapter B.)

Age	14 and over	25 and over	54 and over
Less than 8 years	27.4	29.5	43.7
8 through 11 years	39.3	37.2	37.1
12 through 15 years	28.1	27.2	15.2
16 years or more	5.2	6.1	4.0
	100%	100%	100%

The Water Jar Test (Appendix I A) was mimeographed on 8½" x 11" sheets of paper cut into four "pages" each and reassembled in the form of a small booklet. A staple placed diagonally across the upper left hand corner held them together but allowed easy turning of the pages. The Alphabet Mazes (Appendix I B) were assembled in a similar fashion.

The format of the two tests was thus similar and the directions were as nearly the same as the content of the tests permitted. Each item was on a separate page. Items 1 and 2 were practice items and were explained. The third was a "control" item to determine whether the subject would work the problems in the direct way or the long way before the set was built up. Items 4 through 8 were "set inducers." These were soluble in the long way but not by the direct method. Items 9 through 12 were "critical" in that they could be solved either by the Einstellung or a more direct method. These offered a potential susceptibility score of 0 to 4. After item 12 was a page with instructions to stop and wait for a signal before going ahead. Beyond this was item 13, the "extinction" item, which could not be solved in the Einstellung manner. This item arrangement may be clarified by referring to Appendixes I A and I B.

The answer sheet (Appendix I C) was mimeographed with biographical data blanks at the top for classifying subjects as to age, sex, education and occupation. Space for the Water Jar Test answers was along

the left column. Alphabet Mazes answer spaces were in the column at the right. The standard explanation, read after the first test, is included as Appendix I D.

Procedure. All of the testing was done by the author. Subjects worked individually or in groups of two or three. Usually the experimenter and the subjects were seated at a table or desk. A short period was devoted to promoting rapport. Subjects were told that this was not a test of their individual ability but rather a puzzle on which it was expected different age groups might work differently. A stop watch was always used but it was explained that time was not important. Rather it was pointed out that time was a variable which should be recorded, but that this was not a speed test.

The answer sheet information was filled out first. Then the directions were read aloud by the experimenter. This was found to be desirable since it became apparent in the preliminary study that subjects often said they were ready and had read the directions when they actually had not. Any questions as to the meaning of the instructions were answered as they arose. Occasionally, an individual would "take over" and read the directions aloud himself. This was permitted since the purpose was to be certain the directions were read and understood. Each subject had ample opportunity to ask questions. If he wanted to re-read the directions to himself, this

was permitted. Although the occasion did not frequently arise, the subject could also return to re-read the directions after he began the test. He could not return to the items he had completed, however. Just before beginning the test, subjects in groups were warned not to make comments aloud which would give any clues to the others.

When they were ready, the subjects were told to turn the page and begin. Questions about the material were answered as simply as possible, usually by repeating part of the directions. If this was not adequate, the directions were amplified. Direct questions were usually answered honestly and without evasiveness. Introduction of extraneous sets or encouragement of one type of solution or the other on the control item was avoided. The subject occasionally made arithmetic errors or chose paths that were not continuous or not words on the Alphabet Mazes. These were corrected as they occurred.

A few gave up on the Water Jar Test because they had no real conception of what plus and minus and equals signs meant, although they claimed to follow the directions. These may have been able to comprehend the use of these symbols when written for them but seemed to have no capacity to use them creatively to solve new problems. Similarly, on the Alphabet Mazes, a few seemed totally unable to understand the idea of a continuous path of words. Naturally, these subjects had to be eliminated.

Where only one person was being tested, he was told immediately upon arriving at the "stop" page to go on to item 13. In the groups, this was usually the case also. The time was written down and five minutes allowed. If one reached this page just ahead of another, he usually was told to wait until the other finished. Then they could begin together and timing was simplified.

In the Water Jars Test, there were other possible approaches to the set inducing items which were occasionally hit upon by a subject. This reduced the set effect, of course. No particular type of subject was noted as predictably arriving at these unique solutions. The methods were generally more cumbersome than the Einstellung formula and may be attributed to chance or to some uncontrolled, pre-existing sets. These atypical cases were kept in the sample since eliminating them would be a questionable procedure.

As stated above, the third item of each test was a "control" item, intended to reveal whether the subject had any natural tendency toward the Einstellung solution before any set inducing items were given. It has been held that those using the long approach on this item should be eliminated, since they were acting according to natural preference rather than induced set. It was soon evident, however, that the explanation items were somewhat set inducing themselves. They described two solution procedures, the second being

similar to the Einstellung solution. Thus the "control" item did not adequately serve its purpose. Those solving it in the indirect way did tend to show higher susceptibility scores. This might be expected, however, since it worked as an additional set inducing item for them, and since these subjects would be most evidently responsive to set effects. Out of 600 solutions offered for the control items, 120 were done in the Einstellung way. Of these, 50 were by the older group, 40 by the middle group and 30 by the younger group. Only 8 subjects out of 300 solved both control items in the Einstellung way.

When the first test was finished, the subjects were shown the correct answer to number 13 and the direct solutions to 12, 11, and 10. They referred to these in their booklets while the standard explanation was read. Generally, they gave some expression of insight and amusement at what they had done. Some offered rationalizations. The explanation was explicit enough, however, and apparently all understood, at least at the time, that there was a shorter way on the last items and solution of the last item required changing their approach, and that they were to watch for these on the next test.

Then the second test was administered in the same way as the first. At the end of the second test, the purpose of the experiment

was generally explained in simple terms. Nearly all of the subjects spontaneously said they enjoyed the "puzzles." A large number of them offered to help recruit others to work them. This might also be considered evidence of the acceptability of the tests.

Scoring. The scores for susceptibility on both tests were fairly straightforward. If the subject solved all four critical items in the Einstellung way he received a score of four. If he solved them all in the direct way, his score was zero. If he worked two in the set way and then saw the direct way and changed his score was two, and so on.

The extinction score was more complicated. A direct solution within 2½ minutes which would indicate a rapid overcoming of the set, was scored zero. However, beyond that there were variations which had to be handled arbitrarily. On both tests some subjects arrived at unique solutions. For example, on the Alphabet Mazes a few chose the path "So mice glow." This was a continuous path of words but hardly met the requirements of being "fairly meaningful" as stipulated in the directions. This was scored as indicating set since the subject was generally following the set pattern. Another solution which about four subjects saw was "See ice glow." This was more meaningful and showed more deviation from the set pattern. It was scored zero. Similarly with the Water Jars, some offered the solution 21-7-7+2. This was counted as an awkward way of getting 9 quarts when all that was necessary was filling the 7 and 2 quart jars. Another solution was 21-2-2-2-2-2-2. For the same reason, this was scored as showing set. Still, these solutions were better performances than that of the

individual who stared at the problem for five minutes, repeatedly trying the Einstellung method without success. It was decided to score the latter type 2 and the former 1. Five minutes, however, seemed to be a very long time to reach the relatively easy solutions of the last items which had already been explained in the directions. Accordingly, those who took over 2½ minutes to reach a solution were also scored 1. For identification, those offering the long but accurate solutions discussed above were marked as 1-. Those taking from 2½ to 5 minutes were designated as 1.

Recording. All pertinent data was transcribed to a 5x8" card for each subject. This facilitated handling, sorting and summarizing. Occupations were coded to fit the census records. Scores were recorded on a master sheet for tabulation and cross-comparisons. The raw data are presented in Appendix II.

CHAPTER III

RESULTS

From the design of the investigation it was apparent that a number of comparisons could be made. There are two tests, with two scores on each for every subject. Subjects are divided into three age groups and two sex groups. Half took the Water Jar Test first and half took the Alphabet Maze Test first. The first question to be considered was whether the two tests could be combined for such comparisons as before and after training. Table 6 shows that the *t* ratios between the tests are significant in three out of four comparisons. The Water Jar Test tends to be more set-inducing. The null hypothesis that there is no difference between them is rejected. Therefore simply combining them would be a questionable procedure.

Another question concerns the combination of the susceptibility and extinction scores for a total "set" score. This would offer a wider dispersion with a subsequently better chance of finding significant differences if it were justified. However the two scores represent learning and extinction measures, which are traditionally treated as separate. Guetzgow (8) has presented evidence that different abilities are involved in avoiding and in surmounting set. In addition, it is clear that the two scores have different meanings as

used in this study. It was thus necessary they should be treated separately.

Accordingly, four separate analyses of variance were set up, one for each of the two tests and for each of the two scores. It was expected that these would reveal enough information about the existence of differences to obviate the necessity of computing separate t ratios for each pair of subgroups. The work sheets for these analyses are included as Appendix V. The summaries are presented in Tables 7 through 10. Each of the latter four tables allows F ratio comparisons for three age groups, two sex groups, two order of presentation groups, and the various interactions among these. The within variance is used as the error term in each.

TABLE 6

COMPARISON OF ALPHABET MAZES AND WATER JARS TEST COMBINING SEXES AND ALL THREE AGE GROUPS (EACH N EQUALS 150)

		M	s^2	s_m^2	t
Given as First Test	Water Jars	3.51	1.4461	.0096	3.5237**
Susceptibility	Alph. Mazes	2.93	2.6264	.0175	
Extinction	Water Jars	1.03	.4485	.0030	2.6490**
	Alph. Mazes	.79	.7818	.0052	
Given as Second Test	Water Jars	2.77	2.8744	.0192	.9331
Susceptibility	Alph. Mazes	2.95	2.6951	.0180	
Extinction	Water Jars	.87	.5727	.0038	2.0607*
	Alph. Mazes	.68	.7023	.0047	

*Significant at .05 level; **Significant at .01 level for 149 d.f.

TABLE 7

ANALYSIS OF VARIANCE SUMMARY FOR WATER JARS SUSCEPTIBILITY

Source of Variation	Sum of Squares	d.f.	Mean Square	F
Between age groups (A)	23.3267	2	11.6634	5.7788**
Between sex groups (B)	1.4700	1	1.4700	
Between orders (C)	41.0700	1	41.0700	20.3488**
Interaction AxB	18.6294	2	9.3147	4.6151*
Interaction AxC	16.3802	2	8.1901	4.0579*
Interaction BxC	1.4700	1	1.4700	
Interaction AxBxC	1.2104	2	.6052	
Within	581.2800	288	2.0183	
Total	684.8367	299		

*Significant at .05 level; **Significant at .01 level

TABLE 8

ANALYSIS OF VARIANCE SUMMARY FOR ALPHABET MAZES SUSCEPTIBILITY

Source of Variation	Sum of Squares	d.f.	Mean Square	F
Between age groups (A)	47.1200	2	23.5600	9.5427**
Between sex groups (B)	3.4133	1	3.4133	1.3825
Between orders (C)	.0133	1	.0133	
Interaction AxB	1.7867	2	.8934	
Interaction AxC	14.1067	2	7.0534	2.8569
Interaction BxC	1.9201	1	1.9201	
Interaction AxBxC	13.5199	2	6.7600	2.7381
Within	711.0400	288	2.4689	
Total	792.9200	299		

*Significant at .01 level; **Significant at .01 level

TABLE 9

ANALYSIS OF VARIANCE SUMMARY FOR WATER JARS EXTINCTION ITEM

Source of Variation	Sum of Squares	d.f.	Mean Square	F
Between age groups (A)	15.8600	2	7.9300	17.5793**
Between sex groups (B)	.1633	1	.1633	
Between orders (C)	2.0833	1	2.0833	4.6183*
Interaction AxB	1.4067	2	.7038	1.5602
Interaction AxC	3.2533	2	1.6266	3.6059*
Interaction BxC	.0834	1	.0834	
Interaction AxBxC	1.4800	2	.7400	
Within	129.9200	288	.4511	
Total	154.2500	299		

*Significant at .05 level; **Significant at .01 level

TABLE 10

ANALYSIS OF VARIANCE SUMMARY FOR ALPHABET MAZES EXTINCTION ITEM

Source of Variation	Sum of Squares	d.f.	Mean Square	F
Between age groups (A)	6.8067	2	3.4034	4.6514*
Between sex groups (B)	.9633	1	.9633	1.3165
Between orders (C)	.9633	1	.9633	1.3165
Interaction AxB	.0467	2	.0234	
Interaction AxC	1.6067	2	.8034	1.0980
Interaction BxC	.9634	1	.9634	1.3167
Interaction AxBxC	.1266	2	.0633	
Within	210.7200	288	.7317	
Total	222.1967	299		

*Significant at .05 level; **Significant at .01 level

Analyses of variance. From the summaries, a number of relationships emerge which are relevant:

(1) Age group F's are consistently significant, reaching the .01 level for three measures and falling just short of this for the fourth.

(2) Sex group F's are not significant for any measure.

(3) Order of presentation is significant on only two of the four scores, susceptibility and extinction for Water Jars Test.

(4) None of the interaction F's is significant for the Alphabet Mazes susceptibility or extinction scores.

(5) Age-sex and age-order interactions are significant for susceptibility scores and age-order interaction is significant for extinction scores on the Water Jar Test.

Analysis of F ratios. The analyses of variance allow broad conclusions about the existence of general differences but they do not indicate the specific nature of these differences. In order to gain this sort of understanding, additional comparisons must be made. Accordingly, the means and their standard errors for each sub-group are presented in Tables 11 and 12. These will permit the tracing of specific trends and exceptions. Table 13 lists the t ratios for the different age groups. Sex groups are combined for these comparisons. These tables enable us to make the following more detailed analyses of the significant relationships revealed by the F tests:

TABLE 11

MEANS AND STANDARD ERRORS OF THE MEANS BEFORE EXPLANATION -TRAINING

N = 25 for each group			Younger		Middle		Older	
			M	Sm	M	Sm	M	Sm
Water Jars when given first	Sus.	Male	3.96	.0400	3.48	.2010	3.52	.2653
		Female	3.16	.3250	3.40	.2583	3.56	.2456
	Ext.	Male	1.16	.1249	.76	.1446	1.20	.1292
		Female	1.08	.1145	.76	.1196	1.24	.1447
Alph. Mazes when given first	Sus.	Male	2.88	.3382	2.92	.3312	2.92	.3312
		Female	2.40	.3464	2.76	.3572	3.72	.1780
	Ext.	Male	.80	.1825	.84	.1797	1.08	.1819
		Female	.60	.1634	.64	.1720	.80	.1825

TABLE 12

MEANS AND STANDARD ERRORS OF THE MEANS AFTER EXPLANATION - TRAINING

N = 25 for each group			Younger		Middle		Older	
			M	Sm	M	Sm	M	Sm
Water Jars when given second	Sus.	Male	3.32	.2985	1.92	.3648	3.08	.3105
		Female	2.44	.3610	2.28	.3629	3.60	.2081
	Ext.	Male	.84	.1375	.60	.1414	1.28	.1473
		Female	.44	.1300	.72	.1356	1.32	.1382
Alph. Mazes when given second	Sus.	Male	2.72	.3583	1.88	.3800	3.68	.2216
		Female	3.20	.2646	2.60	.3605	3.60	.2236
	Ext.	Male	.72	.1685	.40	.1526	.92	.1723
		Female	.64	.1622	.44	.1536	.96	.1778

TABLE 13

COMPARISON OF DIFFERENT AGE GROUPS ON THE FIRST AND SECOND TEST, FOR COMBINED SEX GROUPS

First

N = 50 for each group	Susceptibility: Alph. M. Old.	Alph. M. Mid.	Water J. Old.	Water J. Mid.	Extinction: Alph. M. Old.	Alph. M. Mid.	Water J. Old.	Water J. Mid.
M	3.32	2.84	3.54	3.44	.94	.74	1.22	.76
s^2	1.90	2.91	1.60	1.31	.83	.77	.46	.43
sm^2	.0380	.0582	.0320	.0262	.0166	.0154	.0092	.0086
t	1.5474		.4146		1.1179		3.4483**	

	Old.	Yng.	Old.	Yng.	Old.	Yng.	Old.	Yng.
M	3.32	2.64	3.54	3.56	.94	.70	1.22	1.12
s^2	1.90	2.93	1.60	1.50	.83	.75	.46	.35
sm^2	.0380	.0586	.0320	.0300	.0166	.0150	.0092	.0070
t	2.1879*		.0803		1.3498		.7855	

	Mid.	Yng.	Mid.	Yng.	Mid.	Yng.	Mid.	Yng.
M	2.84	2.64	3.44	3.56	.74	.70	.76	1.12
s^2	2.91	2.93	1.31	1.50	.77	.75	.43	.35
sm^2	.0582	.0586	.0262	.0300	.0154	.0150	.0086	.0070
t	.5853		.5061		.2294		2.8823**	

Second

	Old.	Mid.	Old.	Mid.	Old.	Mid.	Old.	Mid.
M	3.64	2.24	3.34	2.10	.94	.42	1.30	.66
s^2	1.21	3.49	1.78	3.28	.75	.58	.50	.47
sm^2	.0242	.0698	.0356	.0656	.0150	.0116	.0100	.0094
t	4.5662**		3.8981**		3.1882**		4.5944**	

	Old.	Yng.	Old.	Yng.	Old.	Yng.	Old.	Yng.
M	3.64	2.96	3.34	2.88	.94	.68	1.30	.64
s^2	1.21	2.49	1.78	2.88	.75	.67	.50	.48
sm^2	.0242	.0498	.0356	.0576	.0150	.0134	.0100	.0096
t	2.5000*		1.5067		1.5430		4.7143**	

	Mid.	Yng.	Mid.	Yng.	Mid.	Yng.	Mid.	Yng.
M	2.24	2.96	2.10	2.88	.42	.68	.66	.64
s^2	3.49	2.49	3.28	2.88	.58	.67	.47	.48
sm^2	.0698	.0498	.0656	.0576	.0116	.0134	.0094	.0096
t	2.0821*		2.2222*		1.6445		.1451	

*Significant at .05 level; **Significant at .01 level

(1) On the first test, whether it was the Water Jar or Alphabet Maze Test, Table 11 indicates that the three age groups show generally increased set with increasing age. Females showed this trend more definitely than the males but the older subjects are most set and the younger least set on nearly all comparisons. One obvious exception is the younger males. This group also showed relatively high susceptibility on the Alphabet Mazes. The middle age group was superior to the younger group on the Water Jars extinction measure.

Referring to Table 13, it is apparent that the older group shows more set than the middle group in all four comparisons for the first test. Only one of these differences is significant, however. The older group is more set than the younger group on three of the four comparisons and significantly so on Alphabet Mazes susceptibility. The middle group is more set than the younger group in three measures but significantly less set on the Water Jars extinction score.

(2) Turning to Table 12, one can see that for the second test, the older group shows more set than the younger group on every comparison except the Water Jars susceptibility for males. This inversion repeats the phenomenon noted on the first measure, and with a different sample. Comparison of means with those in Table 11 indicates clearly that the middle age group benefited most from the training and the older group benefited least. The middle age group shows less set for the second

test than the younger group on every comparison except the Water Jars extinction score for females.

Turning again to Table 13, for the second test, the middle group is seen to be significantly superior to the older group on every measure. However, it is also significantly better than the young group on both susceptibility measures. The older subjects show more set than the younger on all four measures, and significantly more on the Alphabet Mazes susceptibility and Water Jars extinction scores.

From the above analyses, it is apparent that age differences emerge as significant most frequently after training. It seems that the after training scores are mainly responsible for the significant F's for age differences in the four analyses of variance. However, the same trends are generally evident for the first test.

Consider now the interaction effects. These were significant only on the Water Jar Test.

(3) The Water Jars susceptibility scores showed significant age-sex and age-order interactions. The age-sex interaction may be partially attributed to the very set performance of the younger males. Mean trends (Tables 11 and 12) indicate that the females tend to show progressively more set with age on this score but the

males do not. This same sex difference appears on the susceptibility scores for the Alphabet Mazes when taken first.

The age-order interaction may be due to the large susceptibility difference between the middle age groups taking the test first and second. This difference is not paralleled in the other age groups.

(4) The Water Jars extinction scores showed significant age-order interaction. This result seems attributable to the much smaller set effect after training among the younger subjects. This drop is not evident with the older and middle age groups. The older group given the Water Jar Test second actually did worse on this score.

It may be observed that the Water Jars susceptibility scores show the least age differences of the four measures. These scores are most comparable to those used by most workers in this area. This result is mainly attributable, however, to the very set performance of the younger males. The other group means do show progressively more set with increasing age.

Analysis of intra-group improvement. In the above analyses, different groups have been compared. For example, those who took the Water Jar Test second, after the explanation, were compared with those who took it first. It has been assumed that these groups were

comparable, random samples of their respective populations. There is no reason to expect them not to be of equal ability and temperament, since they were arbitrarily placed in one group or the other alternately as they were contacted. Still, it is possible that some of these sub-groups compared were, by chance, different in their beginning tendencies to show set. This points out the usefulness of another comparison. What is the relative "improvement" of each group on their second test, after the training explanation?

It was decided that, since those who had not shown set on the first measure could not improve and since the meaning of the explanation would not be as definite to them as to the others, just those having maximum set scores on the first test would be compared for relative improvement. Table 14 shows this comparison in terms of chi square.

To understand the table, we may trace the meaning of the first figures. Of the older sample, forty-five out of fifty obtained the score of four on Water Jars susceptibility when that test was taken first. Of these, six showed improvement. That is, only six of the forty-five received scores of less than four on the Alphabet Mazes after the explanation. A similar check of the other figures indicated that the middle age and younger samples showed greater improvement in three out of four comparisons.

On the Water Jars first extinction score, so few of the middle age sample showed set on the first test (six out of fifty) that the expected frequency for computing chi square was only 2.83. This is too small for a stable estimate of chi square. Accordingly, the middle and younger samples were combined.

The chi squares indicate significant age group differences in improvement after training on one of the four measures. This is for susceptibility on the Alphabet Mazes when taken after the Water Jar Test. This difference is largely due to the poorer showing of the older group.

It may be noted that there is a better chance of showing "improvement" when the Water Jar Test is given first, since it tends to be more set inducing than the Alphabet Mazes Test.

TABLE 14

RELATIVE IMPROVEMENT OF THOSE IN THE DIFFERENT AGE GROUPS WHO OBTAINED MAXIMUM SCORES ON THE FIRST TEST (COMBINING M AND F)

		Number Showing Set	Improv. Obs.	Improv. Expec.	o-e	$(o-e)^2$	$\frac{(o-e)^2}{e}$
Susceptibility							
	O	45	6	14.17	-8.17	66.75	4.71
Water Jars	M	39	20	12.28	7.72	59.60	4.85
First	Y	43	14	13.54	.46	.21	.02
	Sum	127	40	40	Chi square		9.58**
	O	38	7	11.24	-4.24	17.98	1.60
Alph. Mazes	M	33	14	9.77	4.23	17.89	1.83
First	Y	27	8	7.99	.01	.00	.00
	Sum	98	29	29	Chi square		3.43
Extinction							
	O	18	9	8.50	.50	.25	.03
Water Jars	M	6	5	8.50	-.50	.25	.03
First	Y	12	3				
	Sum	35	17	17	Chi square		.06
	O	19	5	10.33	-5.33	28.41	2.75
Alph. Mazes	M	14	10	7.61	2.39	5.71	.75
First	Y	13	10	7.06	2.94	8.64	1.22
	Sum	46	25	25	Chi square		4.72

*Significant at .05 level; **Significant at .01 level

CHAPTER IV

DISCUSSION

It should be evident that this is not the ultimate study of age differences in problem solving set. Such a study would more successfully yield score differences which were pure and definite measures of set, uncontaminated by operation of extraneous variables. Time, for example, enters into the extinction scores perhaps too heavily. It is difficult to envision a practical test which would not involve some sort of time limit, however, and the meaning of the hindrance effect of set is closely tied to time. In industrial or educational applications, time would seem to be a persistent issue. Older subjects took longer on every phase of the task. This slower speed of work inevitably enters as an additional contaminating element in the extinction score.

The question may be raised as to whether their relative showing of more set might be partly attributed to poor memory. They may simply have forgotten the instructions or the training explanation in some cases. This would still constitute a genuine set difference as operationally measured.

The comparisons in which the middle age sample showed less set than the younger group were not entirely unexpected. Luchins (12)

discussed the large set effects shown by students and attributed them to rote learning methods in schools. Students are rewarded for learning "the way" without being too critical in their classrooms. It might be expected that they would generalize this much reinforced behavior to the Einstellung tasks. This effect was perhaps magnified in that the younger subjects were generally tested in the schools during their regular class time. The experimenter may have appeared in a different role to them. He may have been regarded in the same general manner as a teacher with some sort of special exercise. The middle and older groups more often had a picture of the experimenter as a student trying to get through college. Their attitude was usually congenial and often somewhat condescending. The differential effects of these attitudes are difficult to assess. Brown (3) found differences in set at least among his more ethnocentric subjects when the experimenter assumed a more authoritarian demeanor.

The high school students, especially the 14 and 15 year olds, seemed to find it harder to grasp what was expected of them than those in the middle group. The high susceptibility of the younger males may be attributable to selection of a chance, unrepresentative sample or to some interaction effect with the experimenter. If future investigations show it to be real, it might partially account for the failure of others to uncover age differences. This difference was

not hypothesized, however, and it may be well to avoid any hasty interpretation of it without some further study in which it is specifically tested.

The greater improvement with training of the middle age group may be attributed to superior learning ability, since this sample (and this population) has the highest average education level. If that is the case, the difference is no less real for practical purposes.

Taken altogether, the subjects who took the Alphabet Mazes second did not do appreciably better than those who took it first. When we consider that the explanation specifically showed them that there was a shorter way to work the items and that the last one could be solved easily by changing their method, warning them to avoid these pitfalls on the next test, their failure to do better is certainly difficult to understand.

An explanation can be found in the individual means. Every group taking this test second did better except the young females. This group showed more set than the other group of younger girls. This may be just an artifact of the particular sample, related to their relative facility in working with numbers and letters. It could be that those taking the Water Jar Test first formed the opinion that the tests were hard. This might lead them to perform differently on the Alphabet Mazes than those who took them first.

Again, it is inadvisable to try fitting post hoc explanations to unhypothesized differences.

Actually, it is debatable whether taking advantage of the shorter solution to "critical problems" is really shorter, or the best way to attack a series of problems. It may be faster to apply the formula which has been working than to stop and consider each new problem in the light of all possible procedures. Decisions take time. Surely one reaches a point of diminishing returns in pausing to consider, compulsively, every conceivable approach before proceding to a course of action. The more "effective" person in practical affairs seems apt to show up as more "set" on Einstellung tasks. Luchins' clearest argument on the disadvantage of Einstellung behavior is in relation to the extinction item, wherein a person may strive ineffectively for 2½ minutes or more to solve a simple problem. He observes,

> Einstellung-habituation creates a mechanized state of mind, a blind attitude toward problems; one does not look at the problem on its own merits but is led by a mechanical application of a used method. (12, p. 15)

Rokeach defines the effect somewhat differently, calling problem solving set rigidity when it involves

> ... the inability to change one's set when the objective conditions demand it, as the inability to restructure a field in which there are alternative solutions to a problem in order to solve that problem more efficiently. (18, p. 260)

One certain decision from this study is that people are complex and individually unpredictable in any such complicated behavior as problem solving. Different motives or attitudes were continually entering the picture to effect their performances. Some would see the short way on two critical items and then, unaccountably, return to the long way. Others would see both and ask which was best. Still others would solve several problems in the set way; then come to one on which they would seemingly forget the set method and have to rediscover it. The advantage of large numbers becomes quite apparent in evening out these effects. Explicit instructions and the presence of the experimenter also were helpful in keeping the subjects from going too far astray.

A major source of difficulty in interpretation of scores from the tests used was the failure to get enough dispersion. On the susceptibility measures, far too many earned the maximum set score of four. It would be better to have some means of discriminating among these. Originally, it was planned to combine the susceptibility and extinction scores, obtaining wider dispersion. It was decided, however, that these scores represented different functions and could not be justifiably combined. If any future studies were to be made with these measures, it would seem to be advisable to reduce the number of set inducing items. Of course this might have the effect of limiting

dispersion on the extinction scores. Some balance would be necessary to obtain the maximum spread on both measures.

In spite of the complications discussed above, there are grounds for rejection of the three specific hypotheses to be tested. Although the relationship seems to be a rather complex one, problem solving set effects are related to age differences. The relationship appears generally linear for first administration of the test, without previous training. However, the 20 to 49 year old group in this sample improved relatively more than the others with the training given. Thus, for the second test, the relationship is U-shaped. This may have implications for those working with the problem solving set effects in terms of whether their groups are absolutely naive or have been previously exposed to such effects. In any case, age should be allowed for in some manner in problem solving set studies.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary. Although there seems to be logical and experimental grounds for expecting age differences in problem solving set, such differences have not been reported. This study was designed as a systematic inquiry into age differences in this area. The specific hypotheses to be tested were: (1) There are no age differences in susceptibility to problem solving set. (2) The ability to overcome or surmount an experimentally induced set is unrelated to age. (3) The effect of training in avoiding problem solving set is unrelated to age.

Fifty male and fifty female subjects in each of three age groups were compared: (1) A young group ranging in age from 14 to 19 (Mdn. 16.05), (2) A middle age group, 20 to 49 (Mdn. 31.75), and (3) An older group, 50 to 85 (Mdn. 66.02). These were considered representative of high school, working, and retired populations respectively. The attempt was made to recruit subjects representative of the census population with regard to education and occupation. The groups obtained were actually more representative of "middle class" Americans by income and occupation and generally higher than average in education. All were living in Florida when tested.

Two tests were used. One was a variation of the Luchins Water Jar Test. The other was an adaptation of an alphabet maze test found by Cowen and his associates to be comparable to Luchins' test. Adapted to a booklet form, the two tests were so designed as to be structurally comparable. Two scores were obtained for each. The susceptibility score indicated the degree to which the subject fell into a set way of reaching solutions. The extinction score showed the difficulty he experienced in overcoming the set.

Each test was given first to half of the subjects in each subgroup and second to the other half. After the first test, a "standard explanation" was read to the subject. This pointed out that two solutions were possible in the later problems and one would normally be considered preferable. Furthermore, it showed that the last item, not soluble in the set way, was easily worked by changing to a new method.

Four analyses of variance were carried out, one for each test and each score type. These revealed age differences as the only consistently significant variable measured (.01 level for all but the Alphabet Mazes extinction item, which was significant at the .05 level). Interaction effects were such that an analysis of mean trends was made and t ratios presented to better understand the nature of the differences. These indicated that the older group was generally more

set on all measures than the younger or middle age groups. For the first test given, no consistent trend in the relative superiority of the younger or the middle age group was exhibited. However, on the second test the middle age group was superior to the younger on three out of four measures.

Chi square comparisons of those showing set on the first test revealed that the older groups showed generally less improvement on the second test than the middle and younger groups. This difference is significant on the susceptibility score for those taking the Water Jar Test first ($P = .01$).

Most of the studies in the literature which have found no age differences or assumed there were none, have been using a type of susceptibility score on some form of the Water Jar Test given without training. In the present investigation, this score shows the least age differences of any measure for combined sexes.

However, the measures indicate that age differences do exist in susceptibility to set, ability to surmount set, and especially in trainability in overcoming set.

Conclusions. The following conclusions summarize the findings of this investigation:

(1) There are significant age differences in problem solving set as measured in this study.

(2) Older subjects tended to show more set than the younger or middle groups in most comparisons. They showed more susceptibility to set and less ability to overcome it on the extinction item when it was expedient to do so. Also they were less responsive to the training employed.

(3) There were individual differences within each group. In every category, some avoided falling into a set solution pattern; some overcame the tendency on the extinction item, and some improved after the training session.

(4) The middle age group in this sample seemed most responsive to the training.

(5) The younger males showed an unexpectedly high susceptibility to set.

(6) Since the samples in this study were not strictly representative of their particular age range populations, the results can only be considered as suggestive. They do indicate, however, that caution is advisable in reporting on problem solving set comparisons where age differences are not controlled. This would be particularly true if the age range among subjects used were large.

(7) The three specific hypotheses may be rejected but with varying degrees of confidence. There is definite evidence of age differences

in trainability in avoiding set. Age differences are present but less pronounced in susceptibility to set and ability to surmount set as measured in this study.

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APPENDIXES

APPENDIX I-A

Water Jars

In each of the following items imagine you are sent to a large water supply, such as a lake or a well. You may take water from it and pour it back in. You will have water jars with you which hold different amounts and your job is to get a particular amount of water. You do this by pouring back and forth from one jar to another until you have just the amount required, without any guessing.

Here is an example:

1. You have a 4 quart jar, an 8 quart jar, and a 3 quart jar. You are to get exactly 7 quarts.

Answer: 4 + 3 = 7

That is, you fill the 4 quart and 3 quart jars and you have exactly 7. You will find this written on your answer sheet in its correct place after the number "1."

Now, try this one:

2. You have jars holding 21 quarts and 4 quarts. Get exactly 13.

(Go on to the next page.)

3. You have jars holding 5 quarts, 12 quarts, and 2 quarts. Get exactly 3 quarts.

5, 12, 2 get 3

This may seem a little harder, but the method is almost the same. You may see that by filling the large 21 quart jar and emptying 4 quarts from it into the small jar you will have 17 quarts left. If you empty that 4 quarts and fill the small jar again you will have exactly 13 quarts left in the big jar. This is written:

Answer: 21-4-4= 13

Write this on the line after "2" on your answer sheet.

On the following pages you will find more items of this type. Work each one and mark your answers on the answer sheet provided. Do not mark this booklet in any way. You will be given scratch paper for any figuring you may want to do.

As you finish each item, turn the page and do not turn back to the item. Once you go on to the next page consider the item done and do not return to it.

Do not turn this page until told to do so!

4.

7, 16, 4 get 1

5.

6, 17, 4 get 3

6.

9, 16, 3 get 1

7.

6, 15, 4 get 1

8.

7, 15, 3 get 2

9.

8, 19, 3 get 5

10.

7, 18, 4 get 3

11.

6, 14, 2 get 4

12.

7, 16, 2 get 5

Stop!

Wait for signal before turning this page.

13.

7, 21, 2 get 9

Now, close the booklet and set it aside.

Do not return to any of the items.

APPENDIX I-A

WATER JAR TEST ITEM ANSWERS AND DESCRIPTIONS

	Answer	Description
1.	4 + 3 = 7	Example of addition solution.
2.	21 - 4 - 4 = 13	Example of subtraction solution.
3.	5 - 2 = 3 or 12 - 5 - 2 - 2 = 3	Control item.
4.	16 - 7 - 4 - 4 = 1	Set inducing item.
5.	17 - 6 - 4 - 4 = 3	"
6.	16 - 9 - 3 - 3 = 1	"
7.	15 - 6 - 4 - 4 = 1	"
8.	15 - 7 - 3 - 3 = 2	"
9.	19 - 8 - 3 - 3 = 5 or 8 - 3 = 5	Critical item.
10.	18 - 7 - 4 - 4 = 3 or 7 - 4 = 3	"
11.	14 - 6 - 2 - 2 = 4 or 6 - 2 = 4	"
12.	16 - 7 - 2 - 2 = 5 or 7 - 2 = 5	"
13.	7 + 2 = 9	Extinction item.

APPENDIX I -B

Alphabet Mazes

In each of the following items you will see a number of squares. Each square contains a letter of the alphabet. Start with the letter in the upper right hand corner. You are allowed to move one square at a time in any direction, as long as the move helps to spell out a word. Work from one word to another to the finish point so that the last letter of the last word is in the lower left hand corner.

In the first sample, on the next page, the path is marked for you. To get from start to finish, follow the letters down the right side, spelling "who." Then go diagonally to spell "is." From there to the finish point is the word "it."

2.

Start

				W
		A	Z	
	R	Q	T	
M	L	X	U	
F	J	I	Z	O
Y A	M	N	B	

Finish

It is a little harder, but the method is the same. Just find a path of words from the starting letter to the finish letter at the lower left.

The answer to the second maze is "warm in May." Write this on the line opposite "2" on the answer sheet.

(Go on to the next page.)

1.

Start

				W
		K	H	
	Y	Z	O	
F	J	I	X	
T	I	S	G	

Finish

The whole path, from start to finish spells "who is it." You will find this written on your answer sheet in the correct place after number "1."

Now, look at the second example on the next page.

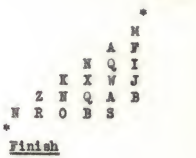
On the following pages you will find more mazes, on which the path has not been marked. Work each one and write your answer on the answer sheet provided. Do not mark this booklet in any way. All of the solutions will be fairly meaningful phrases. In case there is more than one path that will take you from start to finish, the correct solution is the path that uses the fewest squares. As you finish each item, turn the page and do not turn back to the item. Once you go on to the next page, consider the item done and do not return to it.

Do not turn this page until told to do so!

3.

Start
H
I V
S J K
B X W N
E Z M A O
D N O B R
Finish

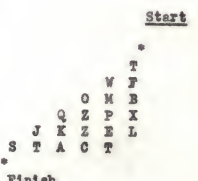
4.


Start
M
A F
N Q I
K X W J
Z N Q A B
N R O B S
Finish

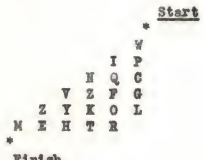
5.

Start
L
E S
T Q E
C Q H F
W F Z I C
G N I S M
Finish

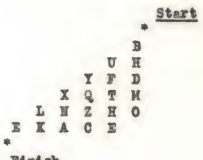
6.


Start
T
W F
O M B
Q Z P X
J K Z E L
S T A C T
Finish

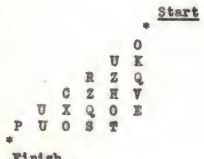
7.


Start
W
I P
N Q C
V Z F G
Z Y K O L
M E H T R
Finish

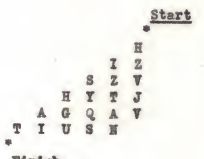
8.


Start
B
U H
Y F D
X Q T M
L N Z H O
E K A C E
Finish

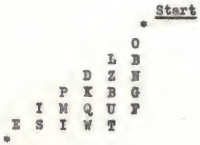
9.


Start
O
U K
R Z Q
C Z H V
U X Q O E
P U O S T
Finish

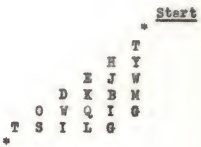
10.


Start
H
I Z
S Z V
H Y T J
A G Q A V
T I U S N
Finish

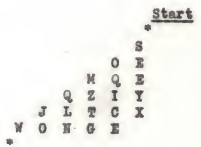
11.



12.



13.



Stop!

Wait for signal before turning this page.

APPENDIX I-B

ALPHABET MAZE ITEM ANSWERS AND DESCRIPTIONS

	Answer	Description
1.	Who is it.	Example similar to last item.
2.	Warm in May.	Illustration of indirect path.
3.	His bed. or His war bond.	Control item.
4.	Man was born.	Set inducing item.
5.	Let him sing.	"
6.	Two pet cats.	"
7.	Win for them.	"
8.	Buy the cake.	"
9.	Our hot soup. or Our cup.	Critical item.
10.	His tan suit. or His hat.	"
11.	Old but wise. or Old pie.	"
12.	The big list. or The dot.	"
13.	See it now.	Extinction item.

APPENDIX I-C

Name _____
Last First Middle

Age___ Sex M___ F___
Education (Circle highest year completed.):
Elementary and High School: 1 2 3 4 5 6 7 8 9 10 11 12
College: 1 2 3 4 5 6 7 8

Occupation: _____
If retired, former occupation: _____

****

Answers

Water Jars:	Alphabet Mazes:
1. 4 + 3 = 7	1. who is it
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.
11.	11.
12.	12.
13.	13.

****

APPENDIX I-D

Explanation

Did you have any trouble with the last problem? Many people do. The trouble is they have found a method that worked on the other problems every time. They try to use it on the last one too and it just doesn't work.

(See last problem.)

Another thing you may or may not have noticed is that several other problems just before that last one could be solved two ways. One of these would ordinarily be considered easier. Chances are pretty good that anyone coming to those later problems right after reading the instructions would work them the simplest of the two ways.

(See example.)

However, if you have just worked a series of other problems using the longer method, you are likely to just go on using the long way wherever it leads to an answer.

This sort of habit can be useful, but it can also lead to trouble and unnecessary work. You may be so used to thinking of only one way of getting an answer that you give up rather than try another way on the last problem. The old way doesn't fit on it. To solve it you have to change to a new method and when you do the solution is simple.

****

The next series of problems will be of a different kind. Try to avoid falling into just one set way of solving them. Remember the advantage of being ready to try a new method.

APPENDIX II

RAW DATA. EXPLANATION OF TERMS USED

Age -- Age at last birthday.

Education -- Highest grade completed.

Occupation -- Coded to fit categories used in United States Census:

1- Not in Labor Force
1. Institution
2. Keeping house
3. Unable to work and other (including students)

2- In civilian labor force
1. Professional and technical
2. Farmers and farm managers
3. Managers (except farm)
4. Clerical
5. Sales
6. Craftsmen, foremen, and kindred workers
7. Operatives
8. Private household workers
9. Service workers
10. Farm labor and farm foremen
11. Labor (except farm)

3- Military

Note: For the younger subjects, this classification was generally according to the father's or mother's occupation. For the older subjects, this was generally according to the primary occupation before retirement. Subjects in the middle age group were generally classified according to their occupation at the time of the study.

Scores are described in Chapter 3. The 1- extinction scores indicate the solution of item 13 within 2½ minutes but in a cumbersome manner, indicating set effect. A score of 1 would mean the subject offered some solution, direct or indirect after 2½ minutes and before 5 minutes. If the subject offered no correct solution before 5 minutes, his score was 2.

APPENDIX II-A. RAW DATA - OLDER MALES

	Age	Educ.	Occup.	Susceptibility Alph.M. 1st	Susceptibility Alph.M. 2nd	Susceptibility Water J. 1st	Susceptibility Water J. 2nd	Extinction Alph.M. 1st	Extinction Alph.M. 2nd	Extinction Water J. 1st	Extinction Water J. 2nd
1.	52	14	2-0	0			4	0			1-
2.	53	14	2-3	4			0	2			0
3.	54	15	2-1		4	0			0	0	
4.	54	11	2-6		4	4			1	1	
5.	55	12	2-3	4			4	1			1-
6.	58	19	2-1	0			1	0			0
7.	60	9	2-9		4	0			0	0	
8.	60	8	2-2		4	4			0	1-	
9.	60	16	2-1		4	4			1	2	
10.	60	9	2-5		4	4			0	1-	
11.	60	8	2-6		4	4			1-	1-	
12.	61	10	2-1		4	4			0	1-	
13.	61	7	2-3	4			0	2			2
14.	61	8	2-7	4			4	0			1-
15.	62	9	2-3	4			1	0			1-
16.	62	10	2-6		4	4			2	1-	
17.	63	8	2-3	0			1	0			1-
18.	64	8	2-4	1			4	2			2
19.	64	15	2-5		4	4			2	1	
20.	64	16	2-3		4	4			1	1-	
21.	64	10	2-4		4	4			2	2	
22.	64	12	2-2	4			4	2			2
23.	66	17	2-9		4	4			0	1-	
24.	66	6	2-2	4			4	2			2
25.	67	8	2-2	4			4	1-			1
26.	67	9	2-6		0	4			0	1-	
27.	67	10	2-6		4	4			0	1-	
28.	67	9	2-6	0			4	2			2
29.	68	11	2-9	3			0	0			0
30.	70	16	2-3		4	0			2	0	
31.	70	7	2-3		4	4			2	2	
32.	71	8	2-6	4			4	1			2
33.	71	16	2-1	4			4	2			2
34.	71	8	2-2		4	4			2	1	
35.	72	16	2-1	4			4	1			1
36.	73	8	2-5	4			4	2			2
37.	74	8	2-4	4			4	2			2
38.	75	8	2-6		4	4			2	2	
39.	75	17	2-1	4			4	0			1
40.	75	4	2-3		4	4			1	2	
41.	77	19	2-1		0	4			0	1-	
42.	77	8	2-9	2			4	1			1
43.	77	16	2-1	0			4	0			0
44.	78	11	2-7	4			4	0			2
45.	79	8	2-5	4			4	2			1
46.	84	8	2-6	3			2	2			2
47.	84	8	2-2		4	4			2	2	
48.	84	8	2-4		4	4			1	2	
49.	84	20	2-1		4	4			1	2	
50.	85	20	2-1		4	4			0	1	

APPENDIX II-B. RAW DATA FOR OLDER FEMALES

				Susceptibility				Extinction			
				Alph.M.		Water J.		Alph. M.		Water J.	
	Age	Educ.	Occup.	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1.	50	13	2-4		0	4			0	0	
2.	52	15	1-2	0			4	0			1
3.	54	9	1-2		4	4			0	1-	
4.	54	12	2-4		4	0			0	0	
5.	56	16	2-4	4			1	0			2
6.	57	16	1-2		4	4			1	1-	
7.	57	11	1-2	4			3	0			0
8.	58	8	1-2	4			4	0			2
9.	58	8	1-2		3	4			2	1	
10.	58	9	2-8	4			4	0			1-
11.	59	10	1-2	4			4	1			1
12.	59	11	1-2	4			4	0			1-
13.	59	11	1-2	4			4	0			2
14.	61	14	2-4	4			4	0			2
15.	61	12	1-2	4			2	1			0
16.	61	8	1-2		4	4			0	1-	
17.	61	8	1-2	2			4	2			2
18.	62	12	1-2	4			4	0			1-
19.	62	12	2-4	4			4	1			2
20.	63	10	2-8	4			4	2			2
21.	64	12	1-2		4	4			1-	2	
22.	65	16	1-2		4	4			1	2	
23.	65	13	1-2		4	4			2	2	
24.	65	9	1-2	4			4	2			1
25.	65	8	1-2		4	4			2	2	
26.	65	8	1-2		4	4			1	1	
27.	66	12	1-2		4	4			0	1	
28.	66	9	1-2		4	4			2	1-	
29.	66	14	1-2		4	4			0	0	
30.	67	15	2-1	4			4	2			1
31.	67	11	1-2		3	4			1	2	
32.	67	14	1-2		0	4			0	2	
33.	68	10	2-4		4	4			1	1-	
34.	68	14	2-1		4	4			0	0	
35.	68	8	1-2		4	4			2	1-	
36.	69	10	1-2	4			0	0			2
37.	69	12	2-9	4			4	2			1-
38.	70	14	2-1		4	4			2	1-	
39.	70	16	2-1		4	4			2	2	
40.	70	13	2-1		4	1			0	1-	
41.	70	12	1-2	4			4	1			1-
42.	70	12	1-2	4			4	0			1-
43.	72	9	1-2	3			4	0			0
44.	72	9	1-2		4	4			0	2	
45.	73	12	1-2	4			4	2			2
46.	75	8	1-2	4			4	2			2
47.	75	12	2-9		4	4			2	2	
48.	75	9	1-2	4			4	2			2
49.	75	12	2-5	4			4	0			1-
50.	77	8	1-2		4	4			1	2	

APPENDIX II-C. RAW DATA FOR MIDDLE-AGED MALES

				Susceptibility				Extinction			
				Alph.M.		Water J.		Alph.M.		Water J.	
	Age	Educ.	Occup.	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1.	20	13	2-6	2			2	0			0
2.	20	13	2-6	4			4	1			1
3.	21	12	2-4	0			4	0			1-
4.	21	12	2-3	4			1	1			0
5.	22	13	2-1		0	4			0	1-	
6.	23	14	1-3		0	2			0	0	
7.	23	14	1-3		0	4			0	1-	
8.	23	15	1-3		4	4			0	1-	
9.	23	13	1-3	4			0	0			0
10.	24	13	2-1	4			1	0			0
11.	25	12	2-1	4			0	0			0
12.	26	13	2-1		1	4			0	1-	
13.	26	15	1-3		0	4			0	2	
14.	26	14	1-3	0			0	0			0
15.	27	15	2-4		4	4			0	0	
16.	28	15	2-5	4			4	0			1-
17.	28	14	2-6		2	4			0	0	
18.	28	12	2-7	4			4	2			1
19.	28	12	2-2		4	4			0	0	
20.	30	20	2-1		4	4			2	0	
21.	30	12	2-7	4			0	0			0
22.	30	17	2-1		0	4			0	1-	
23.	30	16	2-1		4	2			0	1	
24.	31	16	2-6	1			0	0			0
25.	31	16	2-5		4	4			1	0	
26.	31	11	2-7		1	4			2	1	
27.	32	15	2-2		4	4			0	0	
28.	35	11	2-6	4			4	2			2
29.	36	16	2-1	4			0	2			0
30.	36	12	2-1		0	1			0	0	
31.	37	19	2-1		0	4			1	1	
32.	37	7	2-11		0	4			2	2	
33.	38	12	2-9	4			4	1			0
34.	38	11	2-6		4	4			2	1-	
35.	38	12	2-7		0	4			0	1-	
36.	39	12	2-9	0			0	2			1-
37.	40	16	2-1		4	1			0	0	
38.	41	8	2-6	4			2	1			0
39.	41	12	2-3		0	4			0	2	
40.	43	12	2-3		3	2			0	0	
41.	45	6	2-6	0			1	2			2
42.	45	16	2-3	4			0	0			0
43.	45	11	2-6		4	4			0	2	
44.	45	12	2-5	4			1	0			0
45.	46	14	2-7	4			4	2			1-
46.	47	10	2-4	1			0	2			1
47.	48	10	2-3	4			4	2			2
48.	48	12	2-4		0	3			0	1-	
49.	49	15	2-4	4			4	1			1-
50.	49	17	2-1	1			4	0			1-

APPENDIX II-D. RAW DATA FOR MIDDLE-AGED FEMALES

				Susceptibility				Extinction			
				Alph.M.		Water J.		Alph.M.		Water J.	
	Age	Educ.	Occup.	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1.	20	13	2-4	4			4	2			1-
2.	20	12	1-2		2	2			0	1-	
3.	21	12	1-2		4	4			0	1	
4.	22	12	2-4	4			1	0			0
5.	22	14	1-2		0	4			0	2	
6.	23	12	2-4		4	4			1	1	
7.	23	12	2-1	4			4	1-			2
8.	23	14	2-4	4			3	0			0
9.	23	14	2-4		1	4			0	0	
10.	23	13	1-2	4			0	0			0
11.	24	12	2-1	3			0	0			0
12.	24	16	1-2	4			4	1			1-
13.	24	12	2-6		4	0			2	0	
14.	25	12	2-4	4			1	2			0
15.	26	12	2-4	0			2	0			0
16.	26	14	1-2		1	4			1	1	
17.	26	16	2-4	4			0	1-			0
18.	26	12	2-4	4			0	0			0
19.	26	12	1-2	4			4	2			1-
20.	27	12	1-2		0	4			0	2	
21.	28	14	2-4	0			0	0			1-
22.	29	12	1-2		4	4			0	1-	
23.	30	12	1-2	4			4	0			1
24.	30	9	1-2	4			4	2			1-
25.	30	12	1-2	4			0	1			0
26.	31	13	2-4		0	4			0	1-	
27.	31	12	2-4		4	4			0	0	
28.	32	12	1-2		1	4			1	1-	
29.	32	12	1-2		4	4			2	1-	
30.	32	17	2-1		0	4			0	1-	
31.	32	13	2-4		4	0			0	0	
32.	33	12	2-5	0			1	0			1-
33.	33	16	2-4		0	4			0	1-	
34.	34	16	2-4	1			0	0			0
35.	35	13	2-4		0	4			0	1-	
36.	37	11	1-2		4	2			0	0	
37.	38	12	2-5	1			1	0			1-
38.	38	8	1-2	4			4	0			2
39.	38	10	1-2		4	4			0	0	
40.	39	13	2-4		4	4			0	1-	
41.	40	12	1-2	4			4	2			2
42.	41	12	2-9	0			4	2			1-
43.	41	12	2-4		4	4			0	1	
44.	41	14	2-4		4	4			2	1-	
45.	42	12	2-4	0			4	0			1-
46.	45	10	1-2	4			4	0			1
47.	46	12	2-4	0			4	0			1-
48.	46	13	2-4		4	4			0	0	
49.	48	16	2-1		4	4			2	1-	
50	48	12	1-2		4	1			0	0	

APPENDIX II-E. RAW DATA FOR YOUNGER MALES

	Age	Educ.	Occup.	Susceptibility				Extinction			
				Alph.N.		Water J.		Alph.N.		Water J.	
				1st	2nd	1st	2nd	1st	2nd	1st	2nd
1.	14	8	2-3	4			4	1-			0
2.	14	7	2-6		0	4			0	1-	
3.	14	7	2-6		4	4			0	2	
4.	14	8	2-6	4			4	2			2
5.	14	8	2-5		4	4			0	2	
6.	14	8	2-9	1			4	0			1
7.	15	10	2-6	0			4	0			0
8.	15	8	2-4	3			0	0			0
9.	15	8	2-6		4	4			2	2	
10.	15	8	2-5	4			4	0			1-
11.	15	9	2-6		4	3			1-	1-	
12.	15	10	2-3	0			0	0			1-
13.	15	8	3	3			4	0			0
14.	15	8	2-6	4			4	0			2
15.	15	9	3	4			4	1			2
16.	15	8	2-9	4			4	2			1-
17.	15	8	2-1		4	4			0	1	
18.	15	10	2-7		4	4			2	2	
19.	15	9	2-11		4	4			2	2	
20.	16	10	2-11		1	4			0	1-	
21.	16	10	2-1		0	4			0	1-	
22.	16	10	2-6		4	4			2	1-	
23.	16	11	2-5	4			0	0			0
24.	16	8	2-7		4	4			2	2	
25.	16	10	2-6	0			3	1-			0
26.	16	9	2-10		4	4			2	2	
27.	16	10	2-1		0	4			0	0	
28.	16	10	2-1		4	4			0	1-	
29.	16	10	2-1	0			4	0			1-
30.	16	8	2-6	4			4	2			2
31.	17	11	2-3	4			4	0			1-
32.	17	11	2-2		0	4			0	1-	
33.	17	10	2-4		4	4			0	1	
34.	17	10	2-6	4			4	2			1-
35.	17	11	2-6		4	4			1	1-	
36.	17	10	1-2		0	4			0	0	
37.	17	11	2-5	4			4	0			1-
38.	17	10	2-3	4			4	2			1-
39.	17	11	2-2	4			4	2			1-
40.	17	11	2-6	0			4	0			1-
41.	17	8	2-6		4	4			1	1-	
42.	17	11	2-3	1			4	0			1-
43.	18	13	2-5	4			4	1			0
44.	18	11	2-1		4	4			1	1-	
45.	18	11	2-1	4			0	2			0
46.	18	11	2-1	4			4	2			1-
47.	19	12	3		0	4			1	1-	
48.	19	13	2-4		2	4			1-	1-	
49.	19	12	3		4	4			0	1-	
50.	19	12	2-5		1	4			0	0	

APPENDIX II-F. RAW DATA FOR YOUNGER FEMALES

	Age	Educ.	Occup.	Susceptibility Alph.M. 1st	Susceptibility Alph.M. 2nd	Susceptibility Water J. 1st	Susceptibility Water J. 2nd	Extinction Alph.M. 1st	Extinction Alph.M. 2nd	Extinction Water J. 1st	Extinction Water J. 2nd
1.	14	8	2-1	1			4	2			0
2.	14	8	2-1		4	4			0	1-	
3.	14	8	1-2	1			4	0			0
4.	14	9	2-3	4			0	0			0
5.	14	9	2-1	0			1	0			0
6.	14	10	2-6	4			4	1-			2
7.	15	9	2-3		2	4			2	2	
8.	15	9	2-6		3	4			0	1-	
9.	15	8	2-6		4	4			0	1	
10.	15	9	2-11	3			4	0			1-
11.	15	8	2-3	4			4	2			1-
12.	15	9	2-4	1			0	0			0
13.	15	9	2-9		4	4			1	1	
14.	15	9	2-3		4	0			1	0	
15.	15	9	2-1	0			3	0			0
16.	15	8	2-10		1	0			0	1	
17.	15	8	2-6	0			4	0			1-
18.	15	9	2-3	0			4	0			1-
19.	15	9	2-1		4	0			0	0	
20.	15	9	2-1	4			0	0			0
21.	16	11	2-3	4			0	1			0
22.	16	9	2-4	4			2	0			0
23.	16	11	2-7		4	0			0	1-	
24.	16	9	2-4	4			4	2			2
25.	16	9	2-5	4			4	2			1-
26.	16	9	2-6	4			4	1			1-
27.	16	8	2-6		1	4			2	1	
28.	16	9	2-4	0			0	0			0
29.	16	9	2-5	1			4	0			0
30.	17	11	2-3		4	4			2	2	
31.	17	11	2-3		0	4			0	1-	
32.	17	11	2-5		4	4			0	0	
33.	17	11	2-9		4	4			2	2	
34.	17	10	2-6		4	4			0	1-	
35.	17	11	2-9		4	4			0	1-	
36.	17	11	2-5		4	4			0	1	
37.	17	11	2-3	4			0	1			0
38.	17	11	2-6		1	4			1	1-	
39.	18	12	2-9		4	3			0	1-	
40.	18	11	2-11	3			4	2			0
41.	18	10	2-5		4	0			1	2	
42.	18	12	2-6	3			1	0			0
43.	18	11	2-7		4	4			2	2	
44.	18	11	2-6		1	4			1	1	
45.	18	12	2-2	0			4	1			1
46.	18	11	2-1	3			2	0			0
47.	18	11	3	4			0	0			0
48.	18	11	2-9		4	4			0	1	
49.	19	12	3		3	4			1-	1-	
50.	19	13	2-4		4	4			0	1-	

APPENDIX III. ANALYSIS OF VARIANCE TABLES
A. WATER JARS SUSCEPTIBILITY

		O	M	Y	Sum
M	1st	88	87	99	274
	2nd	77	48	83	208
F	1st	89	85	79	253
	2nd	90	57	61	208
Sum		344	277	322	943

Sum Sq means Sum of the Squares. Int. means Interaction.

(G) Total Between Groups Sum Sq.

$$\frac{76693}{25} - \frac{(943)^2}{300}$$

$$3067.72 - 2964.1633 = 103.5567$$

With Order Ignored

	O	M	Y	Sum
M	165	135	182	482
F	179	142	140	461
Sum	344	277	322	943

(G-Order) $\frac{150379}{50} - 2964.1633 = 43.4261$

(1) Between Sex Groups Sum Sq $\frac{(482-461)^2}{2(150)} = 1.47$

(2) Between Age Groups Sum Sq 2987.49 - 2964.1633 = 23.3267

(3) Int. Age x Sex (G-Order)-(1)-(2) = 18.6294

With Sex Ignored

	O	M	Y	Sum
1st	177	172	178	527
2nd	167	105	144	416
Sum	344	277	322	943

(G-Sex) $\frac{152247}{50} - 2964.1633 = 80.7769$

(4) Between Orders Sum Sq $\frac{(527-416)^2}{2(150)} = 41.07$

(5) Int. Age x Order (G-Sex)-(2)-(4) = 16.3802

With Age Ignored

	M	F	Sum
1st	274	253	527
2nd	208	208	416
Sum	482	461	943

(G-Age) $\frac{225613}{75} - 2964.1633 = 44.01$

(6) Int. Sex x Order (G-Age)-(1)-(4) = 1.47

(7) Triple Int. Age x Sex x Order (G)-(1)-(2)-(3)-(4)-(5)-(6) = 1.2104

(8) Total Sum Sq 3649 - 2964.1633 = 684.8367

(9) Within Sum Sq 3649 - 3067.72 = 581.28

APPENDIX III. ANALYSIS OF VARIANCE WORK TABLES
B. ALPHABET MAZES SUSCEPTIBILITY

		O	M	Y	Sum
M	1st	73	73	72	218
	2nd	92	47	68	207
F	1st	93	69	60	222
	2nd	90	65	80	235
Sum		348	254	280	882

(G) Total Between Groups Sum Sq $\frac{66874}{25} - \frac{(882)^2}{300}$

$2,674.96 - 2,593.08 = 81.88$

With Order Ignored

	O	M	Y	Sum
M	165	120	140	425
F	183	134	140	457
Sum	348	254	280	882

(G-Order) $\frac{132270}{500} - 2593.08 = 52.32$

(1) Between Sex Groups Sum Sq $\frac{(425-457)^2}{2(150)} = 3.4133$

(2) Between Age Groups Sum Sq $\frac{264020}{100} - 2593.08 = 47.12$

(3) Int. Age x Sex (G-Order) -(1)-(2) = 1.7867

With Sex Ignored

	O	M	Y	Sum
1st	166	142	132	440
2nd	182	112	148	442
Sum	348	254	280	882

(G-Sex) $\frac{132716}{50} - 2593.08 = 61.24$

(4) Between Orders Sum Sq $\frac{(440-442)^2}{2(150)} = .0133$

(5) Int. Age x Order (G-Sex)-(2)-(4) = 14.0167

With Age Ignored

	M	F	Sum
1st	218	222	440
2nd	207	235	442
Sum	425	457	882

(G-Age) $\frac{194882}{75} - 2593.08 = 5.3467$

(6) Int. Sex x Order (G-Age) -(1)-(4) = 1.9201

(7) Triple Int. Age x Sex x Order (G)-(1)-(2)-(3)-(4)-(5)-(6) = 13.5199

(8) Total Sum Sq 3386 - 2593.08 = 792.92

(9) Within Sum Sq 3386 - 2674.96 = 711.04

APPENDIX III. ANALYSIS OF VARIANCE WORK TABLES
C. WATER JARS EXTINCTION

		O	M	Y	Sum
M	1st	30	19	29	78
	2nd	32	15	21	68
F	1st	31	19	27	77
	2nd	33	18	11	62
	Sum	126	71	88	285

(G) Total Between Groups Sum Sq $\frac{7377}{25} - \frac{(285)^2}{300}$

$295.08 - 270.75 = 24.33$

With Order Ignored

	O	M	Y	Sum
M	62	34	50	146
F	64	37	38	139
Sum	126	71	88	285

(G-Order) $\frac{14409}{50} - 270.75 = 17.43$

(1) Between Sex Groups Sum Sq $\frac{(146-139)^2}{2(150)} = .1633$

(2) Between Age Groups Sum Sq $\frac{28661}{100} - 270.75 = 15.86$

(3) Int. Age x Sex (G-Order)-(1)-(2) = 1.4067

With Sex Ignored

	O	M	Y	Sum
1st	61	38	56	155
2nd	65	33	32	130
Sum	126	71	88	285

(G-Sex) $\frac{14639}{50} - 270.75 = 22.03$

(4) Between Orders Sum Sq $\frac{(155-130)^2}{2(150)} = 2.4167$

(5) Int. Age x Order (G-Sex)-(2)-(4) = 3.2533

With Age Ignored

	M	F	Sum
1st	78	77	155
2nd	68	62	130
Sum	146	139	285

(G-Age) $\frac{20481}{75} - 270.75 = 2.33$

(6) Int. Sex x Order (G-Age)-(1)-(4) = .0834

(7) Triple Int. Age x Sex x Order (G)-(1)-(2)-(3)-(4)-(5)-(6) = 1.48

(8) Total Sum Sq 425 - 270.75 = 154.25

(9) Within Sum Sq 425 - 295.08 = 129.92

APPENDIX III. ANALYSIS OF VARIANCE WORK TABLES
D. ALPHABET MAZES EXTINCTION

		O	M	Y	Sum
M	1st	27	21	20	68
	2nd	23	10	18	51
F	1st	20	16	15	51
	2nd	24	11	16	51
Sum		94	58	69	221

(G) Total Between Groups Sum Sq

$$\frac{4357}{25} - \frac{(221)^2}{300}$$

174.2800-162.8033 = 11.4767

With Order Ignored

	O	M	Y	Sum
M	50	31	38	119
F	44	27	31	102
Sum	94	58	69	221

(G-Order) $\frac{8531}{50} - 162.8033 =$ 7.8167

(1) Between Sex Groups Sum Sq $\frac{(119-102)^2}{2(150)} = .9633$

(2) Between Age Groups Sum Sq $\frac{16961}{100} - 162.8033 = 6.8067$

(3) Int. Age x Sex (G-Order)-(1)-(2) = .0467

With Sex Ignored

	O	M	Y	Sum
1st	47	37	35	119
2nd	47	21	34	102
Sum	94	58	69	221

(G-Sex) $\frac{8609}{50} - 162.8033 =$ 9.3767

(4) Between Order Sum Sq $\frac{(119-102)^2}{2(150)} = .9633$

(5) Int. Age x Order (G-Sex)-(2)-(4) = 1.6067

With Age Ignored

	M	F	Sum
1st	68	51	119
2nd	51	51	102
Sum	119	102	221

(G-Age) $\frac{12427}{75} - 162.8033 =$ 2.8900

(6) Int. Sex x Order (G-Age)-(1)-(4) = .9634

(7) Triple Int. Age x Sex x Order .1266 (G)-(1)-(2)-(3)-(4)-(5)-(6) =

(8) Total Sum Sq 385-162.8033 = 222.1967

(9) Within Sum Sq 385 - 174.28 = 210.72

BIOGRAPHICAL SKETCH

The author was born in Sioux City, Iowa in 1924. He graduated from Manual Arts High School in Los Angeles, California in 1942. He studied basic engineering at Kalamazoo College, Michigan, under the Army Specialized Training Program. After three years in the U. S. Army, he entered the University of Southern California. There he received his A. B. degree in Psychology in June, 1948, and his M. A. degree in Industrial Psychology in June, 1949.

He worked briefly as a social case worker for Los Angeles County. Then, he was employed as examiner in the test development unit of the United States Civil Service Commission in Washington, D. C., for one year. He next accepted a position as Aviation Psychologist with the Human Resources Research Laboratories of the U. S. Air Forces, working in this capacity at McDill Air Force Base in Florida. In September, 1952, he entered the University of Florida, under a graduate fellowship grant, to complete training for his doctoral degree.

He graduated with honors at the University of Southern California, and was a member of Phi Kappa Phi, Psi Chi, and Tau Kappa Alpha, honorary fraternities there. He is an associate member of the American Psychological Association, Florida Psychological Association and the South Eastern Psychological Association, and a student member of the Psychometric Society.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of the committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

June 6, 1955

E. T. Byrn
Dean, College of Arts and Sciences

Dean, Graduate School

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